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**Before the Federal Communications Commission**

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In the Matter of )

Advanced Television Systems )  
and Their Impact Upon the )  
Existing Television Broadcast )  
Service )

**MM Docket No. 87-268**

**COMMENT**

**Fifth Further Notice of Proposed Rule Making  
Submitted 10 July 1996**

**John V. Weaver**  
**President-CEO, Liberty Imaging, Inc.**

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# **FCC--SQUARE PIXELS--STANDARDIZATION**

## **Introduction**

Within the DTV standard resides an SDTV transmission format of 704 X 480 active lines available in either progressive or interlace scanning, 16 X 9 or 4 X 3 aspect ratios, and all field-frame rates proposed.

**The issue we wish to address is that this format contains a major weakness: it does not offer the *option* of selecting "Square Pixels."**

The remedy is to add a square-pixel format of 854 X 480 active lines. To be compliant with the power of 2 computer architecture, the horizontal pixel count could be adjusted to 848, the closest number divisible by 16.

**Liberty Imaging, Inc. (LII) thus strongly urges the FCC to include a Square-Pixels option as essential to the Digital Television (DTV) Standard.**

**Note:** LII and Kollmorgen, Inc., Electro-Optical Division are developing HDTV cameras under a dual-use contract to DARPA. LII is responsible for commercialization. The issue discussed herein has no impact on camera design.

### **What issue?**

This issue has not drawn the attention it may deserve because not only did ACATS, ATSC and The Grand Alliance approve and recommend the format absent a square-pixel iteration but, as stated in the FCC's press release dated May 9, 1996:

"The standard has been endorsed by, among others, a subgroup of the federal government's Information Infrastructure Task Force, the 1994 NIST/ARPA Workshop on Advanced Digital Video, and the Information Technology Industry Council."

### **Why?**

LII suggests that the square-pixel iteration of this standard was rejected because of the laser-like focus of ATSC manufacturing representatives on consumer television receivers which obfuscated the importance of square pixels to:

- major opportunities in emerging applications such as entertainment, multimedia, medical and industrial where square pixels are important;
- the huge new entrepreneurial business potential of a computer compatible square-pixel format to broadcasters, and;
- other standards bodies which depend on the FCC process for leadership.

These implications were either not known or not recognized.

Further, the 704 X 480 format was sought by the ABC Television Network with support from Panasonic. ABC has favored progressive-scan (PrSc) production and transmission. They are considering originating live and live-on-tape programming such as daytime dramas, news and sports in this lower cost SDTV widescreen format not to preclude HDTV which will be based on film-originated programming in prime time.

Because ABC considers PrSc transmission primary they chose to seek a non-square-pixel widescreen format that their infrastructure plans can support. Panasonic has developed a lower-cost studio camera that outputs this standard.

It is also clear that ABC is not the problem. It made a prudent decision given the practical limitations of any business to preserve its avowed objective of implementing PrSc origination and distribution to its affiliates. In fact ABC's strategy increases the potential quantity and variety of DTV programming immediately available to the viewing public.

### **The issue:**

The ATSC/GA meetings were critical in that, although the square pixel format was debated, the ABC proposal was dominant, and with no strong advocacy of a square-pixel iteration present it became expedient to omit the format from consideration.

LII's conclusion is that this issue emerged because the decision was too narrowly based resulting from a lack of awareness of the implications as set forth above.

## **NON-FCC REGULATED CONSIDERATIONS**

By forming the Subcommittee on Alternative Media and Broadcast Interface PS WP4 ACATS opened the process to include technical characteristics required for the Standard to be interoperable with computers. The author was invited to participate on an ex-officio basis with others from the computer, medical, industrial, defense and multimedia worlds. While the committee was essentially made up of television interest who controlled the chair and managed the agenda there was representation from Apple and DEC. The leadership permitted a broad agenda which led to long and spirited debates with plenty of angst to go around. The Final Report (see copy of Executive Summary attached) recommended important technical interoperability attributes be made part of any standard including:

"Square pixels or the option to select square pixel presentation."

**LII thus strenuously urges the FCC to consider the potential impact of square pixels on the successful cross-industry acceptance of DTV as a universal standard.**

### **Government:**

Because LII works closely with users in both the commercial and defense sectors the author feels comfortable in commenting on market factors likely to affect DoD and other government imaging requirements.

The DoD, NASA, NIH and other government interests do not share broadcasting's infrastructure restrictions. Consequently, the 20% data rate increase inherent in the square pixel version of this SDTV format is not a barrier to deployment. However, government interests are forced to rely on the FCC process to establish a sufficiently flexible family of standards to accommodate their needs too.

While DoD and NASA are developing square pixel imaging devices with much higher spatial resolutions, this mid-range format is ideal for many early, less-demanding, high-volume, cost-sensitive applications. The simple addition of PrSc and square pixels makes a profound improvement in image quality over NTSC. It also provides optimal compatibility with current affordable computer-based systems. As an example, any machine gun or other short-range weapon where the gunner's safety can be measurably improved by the addition of an Automatic Target Recognition (ATR) system is a candidate for this format. Currently, the only **affordable**, full-motion video systems that can be deployed for such applications output NTSC and must be de-interlaced and interpolated into square pixels before the data is fed into flat-panel displays.

Question: It is general practice for Government agencies not to interfere with the business of sister agencies. Does that tradition preclude the FCC from taking into consideration the efficiencies and technical benefits that a square pixel option to this SDTV format may accrue to DoD, NASA and NIH applications?

### **Commercialization:**

From first hand observation, LII can attest to the fact that the superior picture quality of the SDTV PrSc **non-square** format versus NTSC is compelling. Those who are ambivalent about square pixels in the medical, multimedia, industrial and some government applications will quickly recognize the opportunity to improve their productivity, capitulate to

non-square to square interpolation, and purchase equipment. The benefits of PrSc and standardization generate a powerful force that can push small imperfections surreptitiously through the pipeline.

For those who require or strongly prefer square pixels (*including the Government*) the alternative is a nonstandard application-specific customized system. In other words the cost-saving benefits of standardization that would permit all users to become more efficient by capitalizing on the broad utilization of interoperable equipment will not be available.

The worst-case scenario is that the availability of only a non-square SDTV standard assures that all systems designers will be obliged to use it including some DoD and other government agencies.

### **Internet & Intranet:**

In cyberspace, much attention is given to "how and when will we have quality video over the Internet?" On June 25th, Columbia University addressed the issue of video-on-demand (VOD) over the Web. Professor Dimitris Anastassiou and his group hosted a workshop devoted to DAVIC (Digital Audio-Visual Council) a proposed international end-to-end system to support multimedia VOD applications across all telecommunications layers worldwide. The latest in VOD Internet working prototypes were demonstrated. Full-motion video and audio were compressed to a 6-Mbp bit stream and fed over the Internet into computer displays. A slightly lower quality system was demonstrated using 1.5 Mbps. The results were impressive. (*To prepare the signal for display on computer screens, NTSC or Pal signals must first be digitized, de-interlaced and the pixels squared up, processes sometimes referred to as interpolation.*)

The lower, more-manageable-than-HDTV data rate of the 704 X 480 progressive-scan 4X3 SDTV format is an obvious target for early adoption by emerging VOD protocols. However, neither the 4 X 3 nor the 16 X 9 version offers the option to select square pixels. The argument is that square pixels are not essential to create great pictures for broadcast television. That's true for CRT's, but not for Flat Panels which are computers. The argument is that "good enough" interpolation technology exists to handle the problem, again, true enough for entertainment programming. However, industries that interact with computer environments and have already established a formidable presence on the Internet, such as medical, machine vision, robotics, defense and business-to-business, are not enamored with non-square pixels. These industries are smitten by progressive-scan SDTV formats because they provide a quantum improvement in resolution, starting them on a pathway to even higher quality imaging that is affordable where HDTV is not. Square pixels are highly desirable and essential because every aspect of the image must be real, not synthesized through interpolation.

In the meantime, a fast-growing phenomenon is taking place that has not received broad publicity. Major corporations are installing larger capacity Intranets. These TCP/IP protocols (Transmission Control Protocol/Internet Protocol) laid over ethernet or ATM networks, for example, will soon offer capacities that can easily handle any SDTV format. While more expensive than the Internet, they are popular primarily because they increase functionality between corporate employees. Intranet interactive communications between computer sites simply works better. Recently companies have started asking suppliers to

install like capacity to speed communications and reduce paperwork. (It seems getting the job done more effectively has its own reward.)

An extrapolation of this trend may be that a second higher-capacity layer will evolve within the Internet for business-to-business communication which is economically justified because these *Intranets facilitate functionality thereby expediting business transactions*. The history of all forms of telecommunications dictates that higher and higher levels of quality and sophistication will follow as improvements in technology permit.

Question: If the FCC perceives a public interest in establishing SDTV standards which can be adopted by other mediums, such as the Internet and Intranets, would it not facilitate that goal to include a square-pixel iteration?

### **Worldwide Standard:**

Confidence is growing that internationalizing America's DTV standard is an achievable goal. The power and influence of America and the American entertainment industry amongst broadcasters worldwide profoundly contributes to this possibility.

I can attest from 30 years of being associated with various aspects of programming, including international, that the business of distributing American-produced television programming and feature films provides a window onto our national character which is seen as fair, trustworthy, and, like it or not, the country that is expected to organize and lead world standardization. We have earned our reputation and this right, but along with it comes the burden of responsibility. I am confident that, when provided with the appropriate assets, the State Department in concert with the FCC International Bureau, will devise a successful strategy to internationalize the DTV standard.

Recently, a World Bank report stated that 20 percent of the world's people live on a \$1 a day or less. While no single country is populated entirely by people living at this incomprehensible level of poverty, many countries-such as China with 22% of the world's population-have low standards of living and poor infrastructures. In these situations the State Department may welcome the option to caution against leaping to HDTV because of the high initial cost of the required infrastructure and consumer receivers. They instead may wish to recommend SDTV as the rational starting point for Third World countries plus India, China and Russia. To reach worldwide agreement, US representatives can argue that the beauty of the American invented flexible family of standards is that SDTV is the pathway to HDTV.

It is not beyond reason that in support of this strategy and beyond the regulatory influence of the FCC, countries that consider SDTV as their best option are likely to permit manufacturers to market lower cost receivers that do not include the ability to display HDTV formats. I am advised that manufacturers may voluntarily agree (or be mandated) to include all formats in all DTV receivers "*sold in the United States.*" Good for us. However, considering the worldwide access to technical knowledge, it is reasonable to assume that if China were to select SDTV as its *starter* standard, Chinese or Taiwanese engineers would be eager to design a lower cost receiver that displayed only SDTV formats for sale in this very large market.

LII supports the internationalization of the DTV Standard and believes its flexibility can make an important contribution to successfully reaching that goal. However, in this context the non-square pixel nature of this SDTV format poses some questions.

1. Can the US as leader foster the notion that infrastructure limited countries can select as their primary video standard, and pathway to HDTV, the lower cost SDTV 704 X 480 format without the option to choose square pixels?
2. By utilizing such a strategy, does the United States risk inadvertently creating a two tiered structure whereby the less wealthy countries form a nonsquare pixel block versus a square-pixel block of wealthy countries? If so are there consequences?
3. Is it in America's public and international business interest to provide a square-pixel option, and therefore choice, to mitigate against this outcome?

**Why this is Important Now:**

The simple truth is that the FCC process has become so dominant that if any format is not included there is scant hope that all the other standards bodies, including display, storage, interface and production, can be persuaded to consider inclusion of a supplemental format. To illustrate the point consider some pertinent structural characteristics of the ATSC:

- Charter Members of the ATSC are: Consumer Electronics Manufacturers Association (CEMA), the Institute of Electrical and Electronics Engineers (IEEE), the National Association of Broadcasters (NAB), the National Cable Television Association (NCTA), and the Society of Motion Picture and Television Engineers (SMPTE).
- The ATSC is charged with making recommendations to the U.S. Department of State (and by implication the FCC) on standards issues to advance at International Telecommunications Union (ITU) meetings.
- The work of the ATSC is divided between two Technology Groups:
  1. **Technology Group on Distribution:** Develops and recommends voluntary national technical standards. All forms of distribution systems may be considered, such as terrestrial broadcasting, cable systems, direct satellite broadcasting and pre-recorded media.
  2. **Technology Group on Production** Develops and recommends voluntary national technical standards for production. (to SMPTE)

With manufacturing members of the ATSC proposing voluntary compliance based on the notion that all DTV receivers would be capable of displaying all FCC transmission formats, the logic is that, if not *unanimous*, some set manufacturers would flood the market with low-cost single-format, possibly SDTV, sets and stymie the growth of HDTV for years. The logic is sufficiently elegant to be probable. In fact it is so elegant that some are advocating that if the FCC doesn't mandate that all receivers be capable of displaying all the DTV standards that is exactly what will happen. Regardless of how this debate is resolved

equipment designers will be loath to include any format that is not part of the DTV Standard.

**Arguments Against:**

Some set manufacturers assert that:

1. If the square-pixel format were adopted the additional information and therefore increased data rate would require more memory bandwidth and pixel-processing capacity to be built into new DTV receivers and because we are at the limit of our technical capability this is not possible, or at the very least it is too expensive. It is hard to believe that with the cost of memory halving every 12 to 18 months that this inadequacy will not correct itself quickly.
2. Downconverting from the square-pixel format to NTSC results in a noticeable loss of picture-quality versus downconverting from the non-square-pixel version. Although LII is not qualified to address this technical point, considering the 350 million existing NTSC receivers, we acknowledge the importance of this issue. If downconverting the 848 X 480 format to NTSC results in a perceptibly lower quality picture then this should be considered.

On the other hand, it is the LII's understanding that an important objective of the FCC is to define standards that will provide stations with the maximum opportunity to develop alternative revenue streams to entertainment. In that event having the option to select a square-pixel format at the 480 active line level of resolution which is optimal for interfacing with business-based Intranets, such as LAN's or WAN's, fosters new business opportunities in new mediums where NTSC is not compatible.

3. The square pixel version will generate such a high quality picture that it may negate HDTV altogether. LII rejects this notion. It is true that current display technology has limitations and is expensive but this only means that there is plenty of headroom for innovation and invention. *This is precisely what is required in a forward looking standard.*

Question: Regardless of the complexity of these arguments, does not the solution reside in near-term technical advancement and business opportunities?

**Implementation Potential:**

LII's preliminary market analysis suggests that the rapid assimilation of a non-square SDTV standard will be facilitated by 3 important realities:

1. Affordable (under \$500) multisync CRT's that will display this format for computer application environments with viewing distances up to 30" are readily available today,
2. Low-cost professional digital cassette tape recorders (Panasonic D-5 at \$40,000) are available off-the-shelf and can record this data rate uncompressed, and,



3. While the new standardized DVD (CD) player outputs NTSC only, the next generation with storage capacity up to 20 Gbytes will be irresistible as a distribution medium for home-theater content to feed new affordable, 60", widescreen DTV projection displays.

Question: Does the potential exist that once the standards are promulgated that market conditions will so favor the 704 X 480 SDTV formats as the starter standard for DTV Spin-off, non-broadcast applications that convergence between Television and Computers is inhibited?

**Recommendation:**

LII believes that the FCC must acknowledge the broader implications in setting DTV standards and revise this SDTV-proposed format to include a square-pixel iteration. LII does not suggest the elimination of the proposed 704 X 480 non-square version but rather advocates extending the flexible intent of the family of standards proposed by ACATS, ATSC and the Grand Alliance

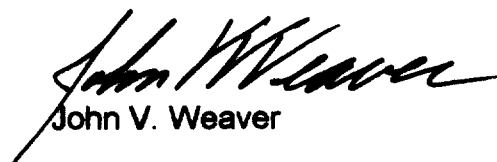
LII asserts that by adding a square-pixel version to this SDTV format the FCC acknowledges the wider implications of setting the DTV standards and:

1. serves the needs of non-broadcast commercial users in the medical, machine vision, robotics and multimedia industries with this important computer compatible attribute;
2. meets the requirements of the DoD, NASA, NIH and other government applications;
3. provides developers of applications for the Internet and Intranets with a low-cost, high-quality, interoperable business-to-business video format;
4. provides broadcasters a format to choose from with *future* broadcast and huge non-broadcast commercial computer interoperability potential;
5. stimulates set manufacturers to include this format in their display packages; and
6. establishes the appropriate precedent for other standards bodies to follow.

One Final Question:

**Why is it necessary for HDTV to have square pixels but not SDTV?**

Thank you for your consideration.

  
John V. Weaver

## **PS-WP/4 FINAL REPORT**

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### **EXECUTIVE SUMMARY**

The objective of Planning Subcommittee Working Party 4 (PS-WP/4) was to study and make recommendations regarding the relationship of terrestrial advanced television systems to alternative media, applications and standards. It was also the objective to investigate approaches for growth paths to the future while, at the same time, to support timely decisions on an advanced television (ATV) broadcast system with increased performance quality for the end user. Participants of Working Party 4 have addressed issues related to interoperability, scalability and extensibility and more generally, openness. Representatives of the broadcast television, cable television, program production, motion picture, computer, telecommunications, and imaging industries were active in this working party.

In the prior year's effort (1991), PS-WP/4 developed definitions of key terms such as interoperability, scalability and extensibility. Based upon a world becoming more complex and richer in alternatives (media, transmission/distribution, presentations), the working party developed the concept of image data, defined as the digital equivalent of the video information including image, sound and auxiliary data components. As a result, PS-WP/4 recommended the following in its December 1991 Interim Report:

- Maximize utilization of digital video techniques and image data representation.
- Apply HEADERS and DESCRIPTORS (as agreed by industry standards groups) as a method of identifying image data.

Once the Systems Subcommittee Working Party 4 (SS-WP/4) established the ten selection criteria, PS-WP/4 adjusted its focus to concentrate on the three criteria that related to alternative media: Interoperability, Scope of Services and Features, and Extensibility.

An assessment of the five proponent systems in reference to the above three criteria was made by PS-WP/4. PS-WP/4 developed an OSI-like layered architectural model for ATV to aid in evaluating the proponent systems along with applications and performance questions on these criteria. PS-WP/4 employed a technical consultant, StellaCom, Inc., to assist in this analysis. The assessments were based upon information supplied by each of the proponents in (1) published form, (2) response to specific PS-WP/4 questions and (3) a three-day Interoperability review involving the proponents and a Special Interoperability Review Board (convened specifically for evaluation of the proponent systems relative to the three criteria and conducted in September 1992). The Review Board consisted of experts across a broad array of relevant disciplines. The selected experts had no relationship to any of the system proponents. Results of the Review Board evaluation weighed heavily in the PS-WP/4 conclusions and recommendations.

PS-WP/4 has identified a number of characteristics that contribute significantly to interoperability, Scope of Services and Features, and Extensibility. These are based on needs and desires exhibited by alternative media advocates, not only for the delivery of terrestrial broadcast television programming but also for other delivery approaches and applications relating to computing, communications, motion pictures and imaging. In relative order of importance, these characteristics are:

- An all-digital implementation based on a layered architecture model
- The use of universal headers and descriptors (as agreed by industry standards group, for example, SMPTE)
- Transmission of the signal in progressive scan format
- Use of a flexible, packet data transport structure
- Viewer transparent channel re-allocation (limited picture and sound while most of the channel capacity is devoted to data transmission for conditional access addressing or other purposes)
- Ability to implement lower-performance, low-cost ATV receivers (comparable price/performance options to current NTSC receivers)
- Ability to implement low-cost ATV consumer VCR
- System architecture and implementation that will allow improvements and extensions to be incorporated as technology advances while maintaining backward compatibility
- ▶ • Square pixels or at least the option to select square pixel presentation ◀
- Compatibility with relevant international standards or commitment to this objective
- Easily-implementable and user-accessible "still/motion multi-window transmission"

The PS-WP/4 assessment and evaluation of the proponent systems shows some significant differences under the three criteria. Further, all proponent systems need improvement on one or more of the listed characteristics to achieve a desirable degree of interoperability, extensibility and scope of services and features. It is recommended that the Special Panel, the Advisory Committee and the FCC take these differences into account in the process of selecting an ATV standard. Furthermore, selection of a system that incorporates interoperability features not included in the system as submitted for testing requires verification and/or testing. The system submitted for field testing should also include such features.

## JOHN V. WEAVER

In 1989 John's interest in High Definition Television as a creative medium motivated him to join the MIT-sponsored HDTV Ad Hoc Group. The potential technological breakthroughs and their economic and social implications proposed by this cross-industry advocacy forum inspired John to participate in the development of interoperable, interactive, digital, high-resolution advanced video production standards. Evolving out of that experience and with the help of government technologist John devoted a year to searching American defense companies for advanced imaging technology. LII was formed and with partner the Kollmorgen Corporation, Electro-Optical Division successfully competed to be part of the ARPA (Advanced Research Projects Agency) funded program to build advanced HDTV cameras. This American effort successfully demonstrated the world's first HDTV progressively scanned video camera at the 1996 NAB.

Some of John's professional activities include:

**FCC Advisory Committee on Advanced Television Subcommittee, PSWP-4-Alternative Media and Broadcast Interface:**  
Formed to examine and recommend technical attributes that would foster low-cost seamless interoperability between over-the-air HDTV digital transmission standards and computer/telephony networks and multimedia.

**"BACK TO THE FUTURE"** 1990 NATPE Convention HDTV Workshop panelist.

**SMPTE** (Society of Motion Picture and Television Engineers) Chair ad-hoc P18 Working Group on Headers/Descriptors (coding architecture for advanced television production required to interface with digital multimedia images).

**OTA** (Office of Technology Assessment), Member Advisory Board to 1990 "HDTV Report to Congress."

**COHRS**: Founding member "Committee for Open High Resolution Systems", cross-industry group advocating interoperability standards to foster low-cost multimedia interactive transmission and display systems.

**ATSC** (Advanced Television Systems Committee) and IEEE (International Electrical and Electronics Engineers) Sponsored Digital Systems Information Exchange 1990, 1991, 1992 & 1993.

**HDTV AD-HOC Group (1989)**: MIT-sponsored information exchange forum. 40 meetings to date.

**MCC** (Microelectronics and Computer Technology Corporation), Consultant to First Cities Project (Major High Technology consortium committed to building digital interactive testbed community).

**Advisory Committee for Media and Information Technology Initiative**, Stevens Institute of Technology.

In 1987 John founded LIBERTY TELEVISION INC. to develop programming for the syndication market. Orbis Communications, Inc. (later CAROLCO Television) provided Liberty its first production. Thirteen half-hour episodes of "CHALLENGE" featuring George Plimpton were syndicated by Orbis. Subsequently 39 additional shows were produced. This success led to a second show for CAROLCO, "Horrible Night at the Movies," a tongue-in-cheek series featuring 13 of the worst movies ever made. This series grew out of John's work on "The Canned Film Festival," a Young & Rubicam, Dr. Pepper syndicated showcase. Another project teamed Liberty with NewsVision to bring the CBC-produced "TOMMY HUNTER SHOW" to American television via the Nashville Network. This star-studded C & W musical variety show was renewed for five seasons.

### **Consultant:**

MULTIMEDIA INC. Strategic planning for digital television technologies.

OTA (Office of Technology) "HDTV Report to Congress."

MCC (Microelectronics and Computer Technology Corporation), First Cities Project.

### **Industry Related Organizations:**

National Association of Broadcasters, National Association of Program Executives, Society of Motion Picture and Television Engineers and New York New Media Association, Regional Plan Association, New York Academy of Science and New York Academy of Television Arts and Science.

### **Clients**

J. Walter Thompson  
The Family Channel  
The Nashville Network  
MCL Designs, Inc.  
Young & Rubicam, Inc.

"Comedy Shop", "Gold Coast"  
"U.S.A.M."  
"Tommy Hunter Show"  
"Pac Man"  
"Canned Film Festival"

### **Developed and/or Produced**

Fast Forward to the Future  
Thanksgiving Day Special  
Really Rosy  
Fortune's Business (Radio)  
Challenge  
Horrible Night at the Movies

Digital Television Report to Congress  
NBC  
CBS  
FORTUNE Magazine  
CAROLCO Television  
CAROLCO Television

### **Staff Positions**

American Broadcasting Co.  
  
Foote, Cone, & Belding  
Blue Ridge Enterprises Inc.  
Ketchum Communications, Inc.  
Syndication Network Sales

TV Network Station Relations  
Radio Network Sales Representative  
TV Network Buyer  
V.P. Program Development  
V.P. Television and Radio Programming  
President/Program Development

EDUCATION: Michigan State University, B.A. Television Management Program